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भारत सरकार/Government of India
विद्युत मंत्रालय/Ministry of Power
केंद्रीय विद्युत प्राधिकरण/ Central Electricity Authority
तापीय अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Thermal Engineering & Technology Development Division
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Date: 19-12-2023

The Secretary,
Central Electricity Regulatory Commission
3rd Floor Chanderlok Building, 36, Janpath,
New Delhi – 110 001

विषय: 01.04.2024 से शुरू होने वाली अवधि के लिए टैरिफ के सीईआरसी नियम और शर्तें - थर्मल पावर स्टेशनों के लिए परिचालन मानदंडों को निर्दिष्ट करना - के संबंध में।
Subject: CERC Terms and Conditions of Tariff for the period starting from 01.04.2024 – specifying of Operational Norms for thermal power stations - reg.

Sir,

This is with reference to CERC File No. L-1/268/2022/CERC dated 19.05.2023 addressed to Chairperson, CEA regarding preparation of operation norms for Hydro and Thermal Power Stations for the tariff period starting 01.04.2024. As regards thermal power stations, CEA has been requested to furnish the recommendations on operation norms in respect of Target Availability, Target PLF, Gross Station Heat Rate, Specific Fuel Oil Consumption, Auxiliary Energy Consumption, Transit Losses, GCV loss on stacking/ handling etc. in due consideration of renewable capacity addition and technical minimum operation of conventional plants.

Separate recommendations on operation norms in respect of impact of 'Scheme for flexibility in generation and Scheduling of Thermal/ Hydro Power Stations through bundling with RE and Storage Power', 'Pooling of tariff of those plants whose PPAs have expired' and 'New Emission Norms' issued by MoEF&CC' on operational norms of units/stations have also been sought.

2. In view of the above, after detailed analysis of Thermal Power Stations's operational data (for the last five years 2018-19 to 2022-23), design data and OEM data, "Recommendation of operation norms for Thermal Power Stations for the tariff period starting 01.04.2024"(copy attached) has been prepared and is submitted herewith.

3. This issues with the approval of competent authority.

Yours' faithfully,

टी वेंकटेश्वरलु 19/12/2023
(टी वेंकटेश्वरलु)
मुख्य अभियंता
(टी ई एंड टी डी)

Recommendations

Reference: Regulation 49 under Chapter 12 in CERC (Terms and Conditions of Tariff) Regulations, 2019:

The recommendations of Central Electricity Authority on plant operation norms in respect of thermal generating stations for the tariff period 2024- 2029 are as below:

A. Normative Annual Plant Availability Factor (PAF)

i) All thermal(coal, lignite and gas based) generating stations, except those covered under clause ii), iii) & iv) : - 85 %

ii) Lignite fired generating stations using circulatory fluidized bed combustion (CFBC) technology and generating stations based on coal rejects:

a) First Three years from Commercial Operation Date (COD): 68.5%

b) For next year after completion of three years of COD : 75%

iii) For following Lignite-fired Thermal generating stations of NLC India Ltd:

a) TPS- II Stage- I & Stage- II : 80%

b) Barsingsar (CFBC) : 75%

c) TPS-II Expansion (CFBC) : 50%

iv) M/s NEEPCO's gas fired thermal generating stations:

a) Assam Gas Based Plant : 70%

B. Normative Secondary Fuel Oil Consumption (SFOC)

i) Coal-based generating stations other than stations at (ii) & (iii) below: 0.50 ml/kWh

ii) For coal based generating stations with front fired boilers : 1.0 ml/kWh

iii) Coal-based generating station of DVC:

Mejia TPS 210 MW Unit- 1 to 4: 1.0 ml/kWh

iv) Lignite-fired generating stations (Pulverised and CFBC): 1.0 ml/kWh

v) Generating stations based on coal rejects : 2.0 ml/kWh

C. Gross Station Heat Rate:

1. Existing Thermal Generating Stations (COD achieved before 1.4.2009):

i) The normative gross station heat rate for coal based thermal generating units/ stations other than those relaxed norms covered under clause (ii) below shall be as under:

200/210/250 MW sets (sub-critical)	2400 kcal/kwh
500-600 MW sets (sub-critical) (TDBFP)	2375 kcal/kwh

Note:

In respect of 500 MW and above units where the boiler feed pumps are electrically operated, the gross station heat rate shall be 40 kcal/kWh lower than the gross station heat rate specified above.

ii) NTPC's coal based thermal generating stations:

Tanda TPS (4x110MW)	2750kcal/kWh

(Note for (i) & (ii) : Normative gross station heat rate has been arrived at considering storage loss of 85 kcal/kg in GCV i.e GCV as received basis (ARB)-85 kcal/kg for coal based stations)

iii) Lignite fired thermal generating stations:

The gross heat rate norms in respect of NLCIL lignite based thermal generating stations shall be as below:

NLC TPS-I (Expansion) (2x210MW)	2710 kcal/kWh
NLC TPS-II Stage I (3x210MW) and NLC TPS-II Stage II (4x210MW)	2880 kcal/kWh

iv) Open cycle gas turbine/ combine cycle thermal generating stations:

The operation norm for existing open cycle gas turbine/ combine cycle thermal generating stations given at CERC Regulation 49(C)(a)(vi) are proposed to be retained.

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2. Thermal Generating Stations (coal & lignite) having COD achieved on or after 1.4.2009:

i) The normative gross station heat rate# of coal-based and lignite-fired thermal generating stations other than those relaxed norms covered under clause (ii) & (iii):

For 200/210/250 MW sets= 1.05 X Design Heat Rate (kcal/kWh)

For 500 MW sets & above= 1.04 X Design Heat Rate (kcal/kWh)

(Note: Normative gross station heat rate has been arrived at considering storage loss of 85 kcal/kg in GCV i.e GCV as received basis (ARB)-85 kcal/kg for coal based stations)

Where the Design Heat Rate of a generating unit means the unit heat rate guaranteed by the supplier at conditions of 100% MCR, zero percent make up, design coal and design cooling water temperature/back pressure.

Provided that depending upon the pressure and temperature ratings of the units, the maximum design turbine cycle heat rate and minimum design boiler efficiency shall be as per the table below.

In case designed turbine cycle heat rate and boiler efficiency are better than these values, the same shall be considered for calculation of unit heat rate.

Pressure Rating (kg/ cm^2)	*150*	170	170
SHT / RHT (^{0} C)	535/535	537/537	537/565
Type of BFP	Electrical Driven	Turbine Driven	Turbine Driven
Max Turbine Heat Rate (kcal/kWh)	1955	1950	1935
Minimum Boiler Efficiency*(Percentage)			
Sub-Bituminous Indian Coal (%)	86	86	86

Bituminous imported coal (%)	89		89		89

Pressure Rating (kg/cm^2)	247	247	260	270	270
SHT / RHT (^{0} C)	537/ 565	565/ 593	593/ 593	593/ 593	600/ 600
Type of BFP	Turbine Driven	Turbine Driven	Turbine Driven	Turbine Driven	Turbine Driven
Max Turbine Heat Rate(kcal/kWh)	1900	1850	1814	1810	1790
Minimum Boiler Efficiency*(Percentage)					
Sub-Bituminous Indian coal (%)	86	86	86	86.5	86.5
Bituminous imported coal (%)	89	89	89	89.5	89.5

* For lignite fired thermal generating station, the minimum boiler efficiency shall be 76% (for pulverised) and 80 %(for Fluidised bed) based boilers.

In case pressure and temperature parameters of a unit are different from ratings given in the above table, the maximum design turbine cycle heat rate & minimum boiler efficiency of the nearest class shall be taken.

For units based on dry cooling system, the maximum turbine cycle heat rate shall be considered as per the actual design or 6% higher than the values given in the table above, whichever is lower.

ii) NTPC's coal based thermal generating stations:

Kanti TPS (2x195 MW)	2500 kcal/kWh

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(Note: Normative gross station heat rate has been arrived at considering storage loss of 85 kcal/kg in GCV i.e GCV as received basis (ARB)-85 kcal/kg for coal based stations)

iii) The gross heat rate norms in respect of NLCIL lignite based thermal generating station shall be as below:

Barsingsar (2x125 MW)(CFBC)	2525 kcal/kWh

iv) The impact of change of BFP drive from steam turbine driven to electric motor driven on unit heat rate shall be mentioned as below:

"In respect of generating units where the boiler feed pumps are electrically operated, the maximum design unit heat rate shall be 40 kcal/kWh lower than the maximum design unit gross heat rate with turbine driven BFP."

The normative heat rate values are arrived after applying the degradation factors given in table at F(1)(i) for coal/lignite based generating stations. In case degradation factors given in table at F(1)(i) are modified, the normative heat rate values need to be corrected accordingly and vice-versa.

3. Gas-based/ Liquid-based thermal generating unit(s)/ block(s) having COD on or after 01.04.2009:

The existing operation norms as at CERC Regulation 49(C)(c) are proposed to be retained.

D. Auxiliary energy consumption

1. Coal Based Thermal Generating Stations:

i) Coal-based thermal generating stations except at (ii) & (iii) below:

	(Auxiliary energy consumption ## as % of gross generation) With NDCT/Once-through
200/210/250 MW sets	8.5%
500-600 MW sets with TDBFP (sub-critical)	5.25%
660-800 MW with TDBFP (Super-critical)	5.25%

In case of thermal units of 500 MW and above with electrically driven Boiler Feed Pumps, the auxiliary energy consumption allowed shall be 8.0%.

In case of thermal generating stations provided with Induced Draft Cooling Tower (IDCT), the additional auxiliary energy consumption allowed shall be 0.5%.

In addition, thermal generating stations provided with tube and ball mills, the additional auxiliary energy consumption allowed shall be 0.8%.

In case of thermal generating stations provided with Dry Cooling Systems, the additional auxiliary energy consumption allowed shall be as below:

Type of dry cooling system	(% of gross generation)
Direct cooling air cooled condensers with mechanical draft fans	1.0%
Indirect cooling system employing jet condensers with pressure recovery turbine and natural draft tower	0.5%

ii) NTPC's coal based thermal generating stations:

Tanda Thermal Power Station (440 MW)	12%

iii) DVC's coal based thermal generating stations:

Chandrapur Thermal Power Station (2x250 MW)	9.50%

2. Lignite Based Thermal Generating Stations:

i) For all pulverised lignite fired thermal generating stations with 200 MW sets and above, the auxiliary energy consumption norms shall be 0.5 percentage point more than the auxiliary energy consumption norms of coal-based generating stations except at (ii) below.

ii) M/s NLCIL's pulverised lignite fired generating stations:

TPS-II stage- I (630 MW)	10%
TPS- II stage- II (840 MW)	10%

iii) For lignite fired thermal generating stations using CFBC technology, the auxiliary energy consumption norms shall be 1.5 percentage point more than the auxiliary energy consumption norms of coal-based generating stations except at (iv) below.

iv) M/s NLCIL's CFBC technology based lignite fired generating stations:

Barsingsar TPS (2x125 MW)	12.5 %
TPS-II Expansion (2x250 MW)	12.5 %

The Auxiliary energy consumption values are arrived after applying the degradation factors given in table at F(1)(ii) for coal/lignite based generating stations. In case degradation factors given in table at F(1)(ii) are modified, the Auxiliary energy consumption values need to be corrected accordingly and vice-versa.

3. Gas Turbine/ Combined Cycle Generating Stations:

i) Gas turbine/ combined cycle generating stations, except those at (ii) below:

a) Combined cycle generating stations : 2.75%

b) Open cycle generating stations : 1.0%

In case of Combine Cycle Generating Stations using electric motor driven Gas Booster Compressor, the Auxiliary Energy Consumption shall be 3.30% (including impact of air-cooled condensers for Steam Turbine Generators).

Further additional Auxiliary Energy Consumption of 0.35% shall be allowed for stations having direct cooling air cooled condensers with mechanical draft fans.

ii) a) NEEPCO's Tripura CCPP (101 MW) : 3.5%

b) OTPC Palatana CCPP (726.6 MW) : 3.5%

E. Annual Plant Load Factor (PLF) for Incentive

The level of Annual Plant Load Factor (PLF) for Incentive is recommended **at the same level** of Normative Annual Plant Availability Factor (NAPAF) for the station for the year.

F. Impact of Part Load Operation on Performance of Thermal Generating Stations:

1. Coal/ lignite based thermal generating stations:

i) Impact on station heat rate:

The applicable factors for unit heat rate degradation at part loading for sub-critical and super- critical units are proposed as follows:

		Unit HR degradation (%)	
Sl No	Unit loading (%)	Sub-critical units	Super-critical units
1	85-100	Nil	Nil

2	80 - <85	2.1	1.8
3	75 - <80	3.0	2.5
4	70 - <75	4.0	3.3
5	65 - <70	5.1	4.1
6	60 - <65	6.1	4.9
7	55 - <60	7.6	6.0
8	50 - <55	9.35	7.7
9	45 - <50	11.9	10.7
10	40 - <45	14.2	13.2

ii) Impact on auxiliary energy consumption:

The admissible additional auxiliary energy consumption values at part loading of coal/ lignite based thermal generating stations are proposed as follows:

Sl. No.	Module/ plant loading as % of installed capacity	Admissible % degradation in auxiliary energy consumption **(% point)**
1.	85 -100	Nil
2.	80 - < 85	0.5
3.	70 - < 80	1.1
4.	60 - < 70	1.8
5.	50 - < 60	2.5
6.	40 - < 50	3.2

iii) Impact on SFOC:

Considering flexible operation requirement of coal based thermal stations in view of capacity addition from renewable sources, additional specific oil consumption of 0.2 ml/kWh is proposed to be provided for units operating in 40-55% average loading.

2. Gas/ liquid fuel based thermal generating stations:

i) Impact on station heat rate:

The degradation of module/ plant gross heat rate for gas/ liquid fuel based thermal generating stations in CCGT mode of operation are proposed to be considered as below:

Sl. No.	Module/ plant loading as % of installed capacity	Increase in module/ plant heat rate (%)
1.	85 -100	Nil
2.	80 - < 85	2.5
3.	70 - < 80	5
4.	60 - < 70	8
5.	50 - < 60	12

ii) The degradation of module/ plant heat rate for gas/ liquid fuel based thermal generating stations in Open cycle mode of operation are proposed to be considered as below:

Sl. No.	Module/ plant loading as % of installed capacity	Increase in module/ plant heat rate (%)
1.	85 -100	Nil
2.	80 - < 85	3
3.	70 - < 80	7
4.	60 - < 70	11
5.	50 - < 60	16

iii) Impact on auxiliary energy consumption:

The additional auxiliary energy consumption admissible at part loading of gas/ liquid fuel based thermal generating station is proposed to be considered as below:

Sl. No.	Plant/ module loading as % of installed capacity	Admissible % additional auxiliary energy consumption (% point)
1.	85 -100	Nil
2.	80 - < 85	0.25
3.	70 - < 80	0.50
4.	60 - < 70	0.80
5.	50 - < 60	1.20

G. Transit losses of coal:

i. Transit loss in case of Thermal Power Plants (TPPs) transporting coal more than 50%, through Captive mode (i.e MGR, belt, pipe conveyor etc.) shall be 0.2%.

ii. Transit loss in others shall be 0.8%.

H. Reagent and auxiliary energy consumption due to implementation of DeSOx system and DeNOx system:

The recommendations of CEA on admissibility of reagent consumption and auxiliary energy consumption on account of implementation of DeSOx system and DeNOx system towards compliance of new environmental emission norms are as below:

1. Reagent consumption:

i) Limestone consumption of wet limestone based FGD system:

Specific limestone consumption on gross generation basis =

$$\frac{K \times \text{Normative heat rate (kcal/kWh)} \times \text{Sulphur content of coal (\%)}}{\text{GCV of coal (kcal/kg)}} \text{ kg/kWh}$$

Where,
K= 35.2 for units to comply with SO_2 emission norm of 100/ 200 mg/Nm^3.
= 26.8 for units to comply with SO_2 emission norm of 600 mg/Nm^3.

ii) Lime consumption of lime spray dryer/ semi dry FGD system:

Specific consumption 90% purity lime (CaO) on gross generation basis = 6 g/kWh

iii) Sodium bicarbonate consumption of dry sorbent injection system:

Specific consumption of 100% sodium bicarbonate on gross generation basis = 12 g/kWh

iv) Limestone consumption of CFBC power plants (furnace injection):

Specific limestone consumption on gross generation basis =

$$\frac{62.9 \times \text{Normative heat rate (kcal/kWh)} \times \text{Sulphur content of coal (\%)}}{\text{GCV of fuel (lignite) (kcal/kg)}} \text{ g/kWh}$$

v) Urea consumption of SNCR system:

Specific consumption of 100% urea on gross generation basis = 1.2 g/kWh

vi) Ammonia consumption of SCR system:

Specific consumption of 100% ammonia on gross generation basis = 0.6 g/kWh

2. **Auxiliary energy consumption:**

i) Wet limestone based FGD system:

Normative auxiliary energy consumption for wet limestone FGD system= 1% of gross generation of the power plant.

ii) Sea water based FGD system:

Normative auxiliary energy consumption for sea water based FGD system= 1% of gross generation of the power plant.

iii) Lime spray dryer/ semi dry FGD system:

Normative auxiliary energy consumption for lime spray dryer/ semi dry FGD system= 1% of gross generation of the power plant.

iv) Additional auxiliary energy consumption for provision of Gas-Gas Heaters (GGH):

For FGD envisaged with GGH, additional auxiliary energy consumption= 0.2% of gross generation of the power plant/ unit.

v) Additional auxiliary energy consumption for provision of SCR:

Normative auxiliary energy consumption for installation of SCR system= 0.2% of gross generation of the power plant/ unit.

The above proposed norms for reagent consumption and auxiliary energy consumption in respect of DeSOx systems and DeNOx systems are suggested to be reviewed after sufficient operational data is available in due course of time.

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